

Influence of climate change on the flowering of temperate fruit trees

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Introduction

Winter chilling is necessary for the flowering of temperate trees. The chilling requirement is a criterion for choosing a species or variety at a given location. Also chemistry products can be used for reducing the chilling-hours needs but make production more expensive.

This study analysed the observed values of chilling hours in Spain for the last three decades (1970-2000) and their projected changes under climate change scenarios.

Methodology

- Minimum and maximum daily temperature (Tmax, Tmin) from the climatological database Spain02 for the period 1970-2000 was used as baseline.
- Hourly temperature was calculated from Tmax and Tmin by using the De Wit et al. (1978) approach.
- Chilling-hours have been calculated from the 1st of November to the 1st of March by different methods and crops:
 - North Carolina method (Shaltout and Unrath, 1983) for apples.
 - Utah method (Richardson et al., 1974) for peach.
 - De Melo-Abreu et al. (2004) for olive trees and grapevine.

Chilling hours future projections:

- The influence of climate change in temperate trees was studied by calculating projections of chilling-hours with climate data from Regional Climate Models (RCMs) at high resolution (25 km) from the European Project ENSEMBLES, from 1950 to 2050.
- Chilling hours projections for current climate (1970-2000) generated with RCMs were validated with Spain02-based chilling hours.
- These projections will allow for analyzing the modeled variations of chill-hours between 2nd half of 20C (1970-2000) and 1st half of 21C (2020-2050).
- As a first step, chilling-hours for all the period 1950-2050 were calculated for the same months of the year that for the baseline data (November to March).

Results

VALIDATION (1970-2000)

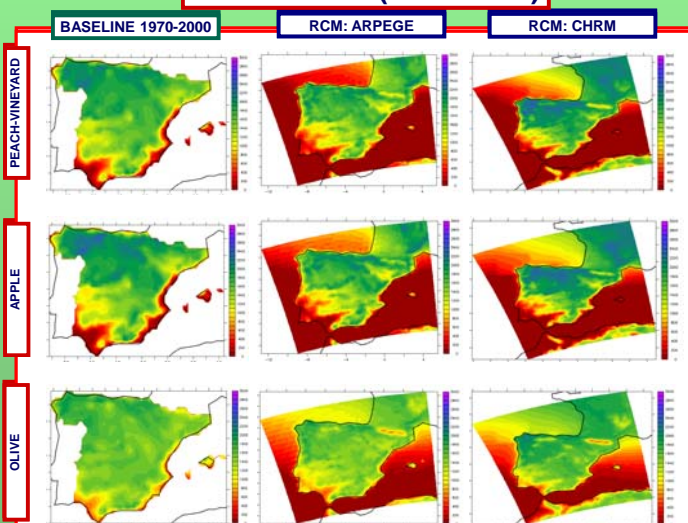


Fig. 1. Validation: comparison of chilling hours calculated with Spain 02 baseline data and with two RCMs for the same period and three crops. Scale is in °Ch

APPLICATION: CHANGE (2020-2050)-(1970-2000)

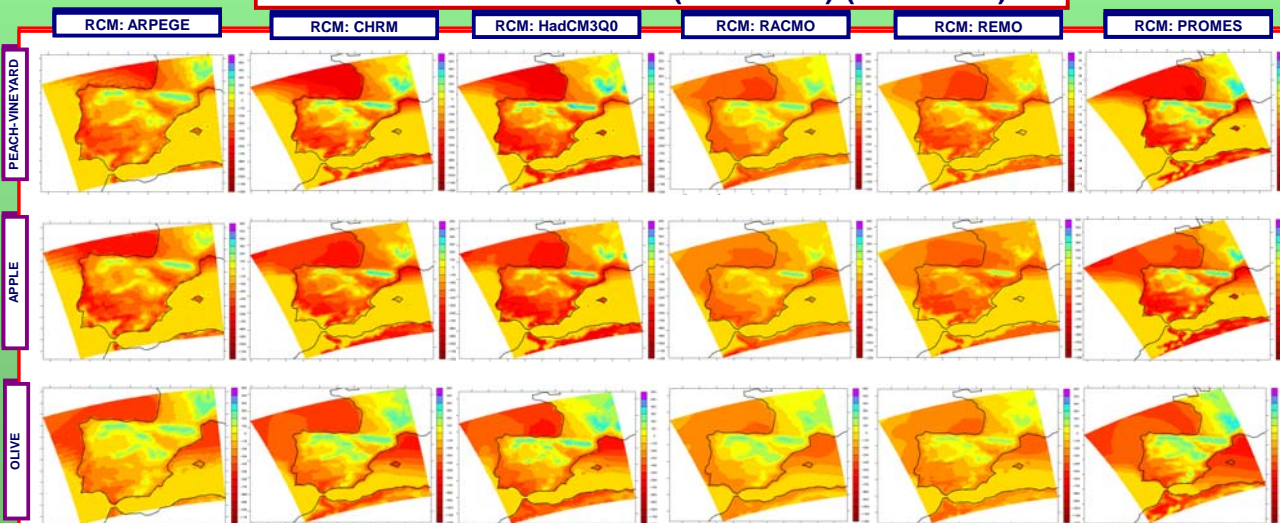


Fig. 2. Projections of climate change impact: variation of chilling hours variation between current (1970-2020) and future (2020-2050) periods calculated with data from six RCMs, for three crops. Scales indicate increase/decrease in °Ch.

- RCMs are a suitable tool for the assessment of chilling hour change in future climate, as the validation shows (Fig. 1).
- Areas traditionally producing fruit as the Ebro (NE) or Guadalquivir (SO) valleys, so as the areas of Murcia (SE) and Extremadura (SO) could have a major cold reduction of chill-hours. It would produce a change of varieties or species or may enhance the use of chemicals to complete the needs of chill hours for flowering (Fig. 2).
- On the case of the olive, cultivated mainly in Andalusia (S), in the eastern area an increase or maintenance of chill hours could occur, while in the western a strong decrease is projected (Fig. 2).
- The decrease of chill hours for olive projections was always smaller than for apple or peach (Fig. 2).

References

- De Melo-Abreu JP, Barranco D, Cordeiro AM, Tous J, Rogado BM, Villalobos FJ. 2004. Agric. Forest Meteorol., 125: 117-127.
- De Wit CT, Goudriaan J, Van Laar HH. 1978. Simulation of assimilation, respiration and transpiration of crops. Pudoc, Wageningen, The Netherlands.
- Richardson EA, Seeley SD, Walker DR. 1974. HortScience, 9: 331-332.
- Shaltout AD, Unrath CR. 1983. J. Amer. Soc. Hort. Sci., 108: 957-961.

Discussion and Furtherwork

- The climate change would produce an increase in temperature and also a shift in seasons. Our next step is to determine what the real period of chilling accumulation should be in future projections. These first results overestimate the reduction of chilling hours because the applied methods decrease the amount of chill hours with moderate temperature, so we must determinate the maximum number of chill hours that are estimated in each projection.
- Bias correction of RCMs for Tmax and Tmin regarding Spain02 database could be tested, to increase the accuracy of projections.

Acknowledgements

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